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An Improvement in Winding Equatorial Clocks.

By A. F. Lindemann.

All equatorial clocks are, as far as I am aware, disturbed during winding ; but the disturbance is usually hidden by the momentum of the heavy governor. My intention being to detect and correct all driving errors, I constructed an exceedingly light governor, weighing about $\frac{1}{4}$ oz., and rotating 540 times a minute, the clock being corrected every second by a main pendulum clock. With this arrangement the winding error was most conspicuous, until the new winding was introduced, with the result that a star set to the vertical line of the micrometer and observed with a power of 214 showed absolutely no movement during the most irregular starting, winding, or stopping. The construction of new winding is as follows (Plates 14 and 15, figs. 1, 2 and 3) :

I took barrel out of clock (an old one by Cook) and inserted in its place a double V-grooved cast iron sheave (1 and 2) and fixed it to the axle C by a steel screw and by a pin resting against one spoke of the main driving wheel D. Exactly under the axle C I placed the winding axle E, held in position on one side by a screw and washer, on the other by a ratchet-wheel R and ratchet *r* and a double V-grooved cast-iron sheave 1_1 and 2_1, of the same dimensions as 1 and 2, and carrying on the prolongation of E the winding crank *d*. Ratchet-wheel and sheave are soldered to E. Fixed to the iron clock support G is the fork H, which carries at the outer end the axle I, upon which the ⌣-grooved loose sheaves *a b* and a_1 b_1 are placed, secured on both ends by washers and screw heads. Under this fork and just in front of clock support G are fixed by means of a plate and axle the ⌣-grooved guiding rollers *c* and c_1. An endless clock string, with long splice of 3 feet and about $\frac{3}{16}$-inch thick, carries the weight P and counter weight *p* as seen in fig. 3, and starting say at β, passing on *c* and the front of 1 returns to top of *a*, crossing over to 2, whence it returns over top of *b* down to sheave r^1, carrying counter weight *p*, rises on the other side to sheave b_1, passing on and under 2_1, from there crossing over to and under a_1 and over to and under 1_1, from which it passes on to c_1, descending to sheave R (to which is attached the large driving-weight P), and returns from there to β. The action is obvious, the weight P is always with $\frac{P}{2}-\frac{p}{2}$ on driving wheel D. During winding the same is the case, and consequently there is no change in the clock's rate. When winding, all that happens is that the string with P is pulled up by sheave 1_1 and 2_1, the weight *p* descending the same amount. The ratchet prevents the turning back of axle E with its sheaves, and the whole winding is done by friction. I rejected the chain, which would have been simpler,

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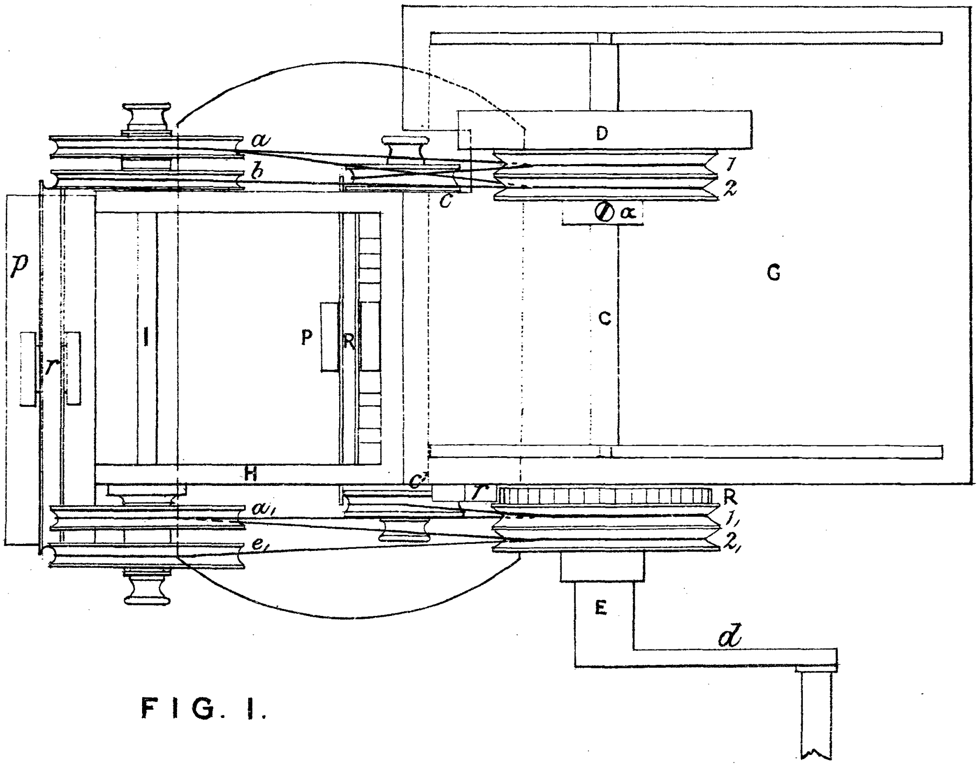

FIG. 1.

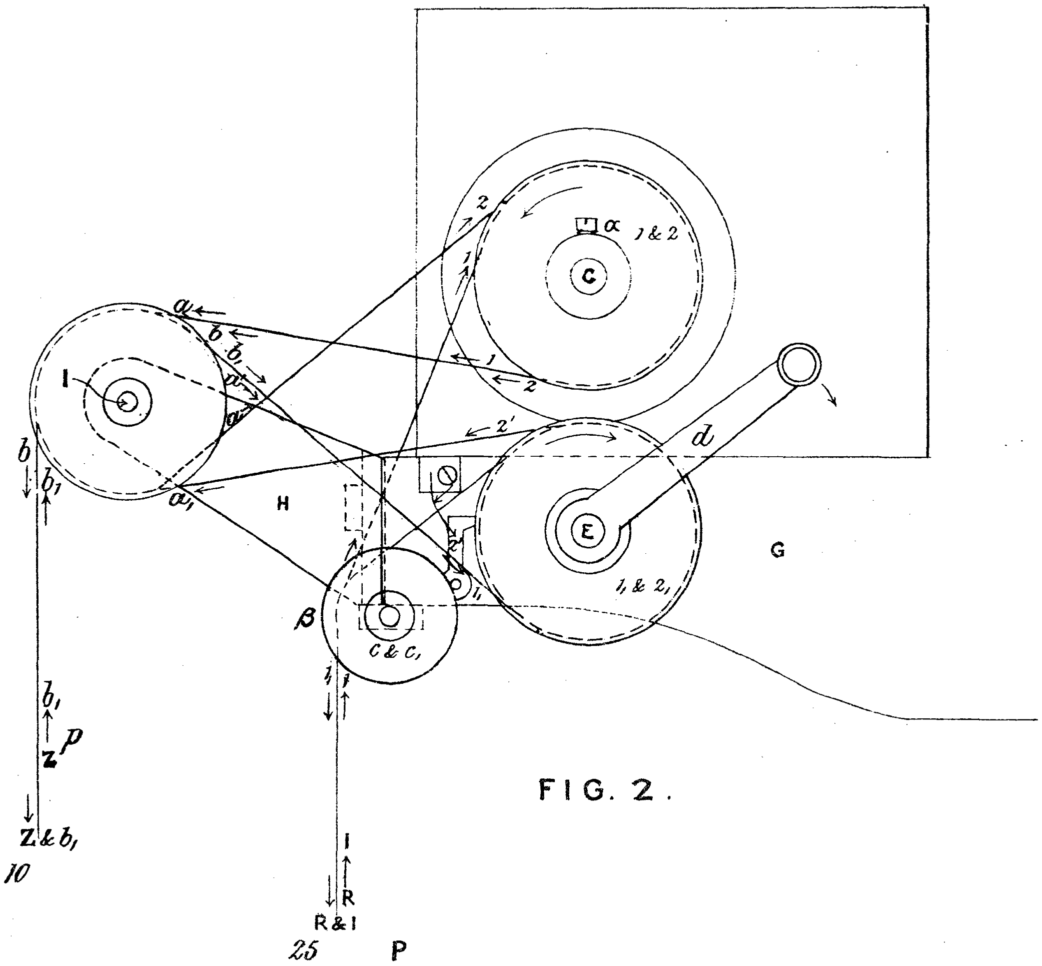

FIG. 2.

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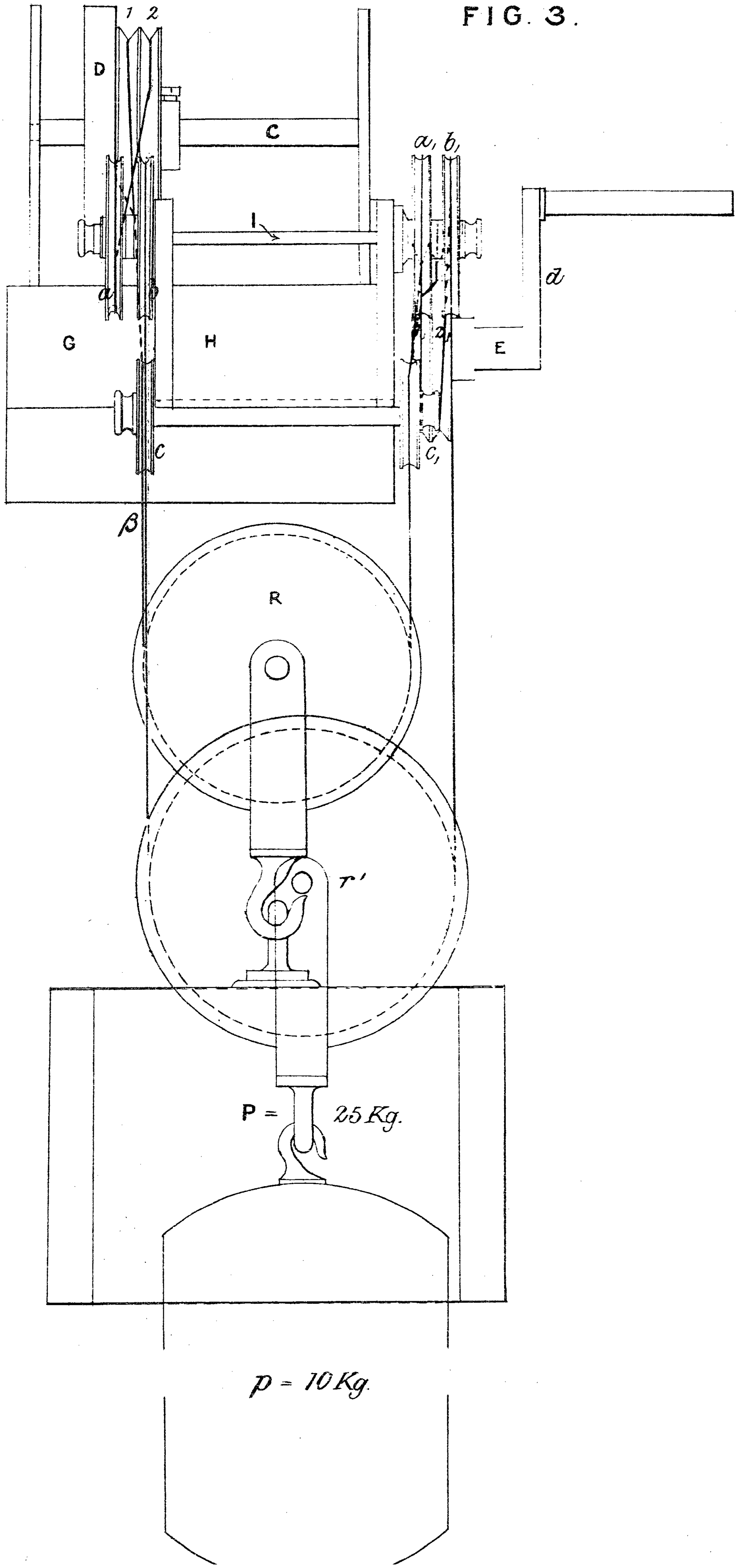
FIG. 3.



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on account of the possibility of uneven working, and fearing that each link might show, which is here avoided. The position of the pulleys *a b* and a_1 b_1 have been so calculated that they give the greatest amount of frictional angle upon 1 and 2 and 1_1 and 2_1. The friction was primarily calculated and proved a perfect success. The weight *p* can be lifted without the string slipping. The position of the various sheaves to one another is also most important, the string having to pass itself several times on each side without touching. Cast-iron was chosen, having a great frictional resistance. Naturally in a new clock the arrangement could be made much more compact. This method of winding, the idea of which is old and well known, is only new in so far as it acts without a chain and entirely by friction.

This winding has been in constant use during the last eight months in my observatory with perfect success.

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